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PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(72) IMPROVEMENTS IN OR RELATING TO ELECTRIC MOTORS AND THEIR ASSEMBLY

(71) I, GIORGIO GUTRIS an Italian Citizen of 49, Viale Certosa, Milan, Italy, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement: —

The invention relates to electric motors of the kind (hereinafter referred to as the kind described) including a casing consisting of a substantially cylindrical middle component open at both ends and having the motor stator fixedly secured therein and two disc-shaped end components supporting bearings for a motor shaft carrying a rotor, the end components having peripheral portions secured respectively in abutting relationship to the ends of said middle component.

The invention is concerned mainly with the production and assembly of fractional H.P. motors, having a relatively small rated output, e.g. a few hundreds of watts, at the most, and of those motors for which, owing to their features and/or to conditions and requirements of installation and service, no overhauling or reconditioning operations are anticipated or planned. The invention is thus intended as an advance and a contribution in the field of the most modern industrial and economical trends according to which motors, mass-produced on the basis of highly advanced and precision techniques, should not be liable to failures or to noticeable wear and tear under normal operating conditions, and according to which in the exceptional event of a motor breakdown, the whole motor is replaced instead of having it repaired or reconditioned. In many cases it is both economically and technically more convenient to replace a broken down motor than to have it repaired, since any repair is a time-consuming operation, may result in a lengthy discontinuation of the operation of machine or other device driven by the motor and requires highly skilled specialists.

The known conventional techniques of electric motor manufacture do not comply with the above-outlined requirements, although they meet all the conditions necessary to ensure the highest efficiency of the manufactured motors. According to current art, a separate production and machining to close tolerance of the motor casing is required, whereafter the stator assembly is centered and fastened within the casing; then, both end plates, carrying the shaft bearings, are secured to the casing, the shaft having the rotor assembly coaxially secured thereto. Machining of high precision is necessary for all the components of the frame, i.e. the casing and head members, and of the parts such as screws, bolts, studs and the related through or dead, threaded or plain holes by which the frame components are firmly secured together.

These machining operations that are carried out on individual components, have to be performed with very close tolerances, above all as regard the accurate co-axiality of the assembled components. A highly accurate machining is required for the annular centering surfaces, since a mutual engagement under stress results in irregular deformations, and also makes a possibly-required subsequent disassembly of frame more difficult, whilst a fit which is too loose can prejudice said co-axiality.

Even if the frame components have been most precisely manufactured, the assembly thereof can cause a defective arrangement. The use of screwed elements for securing such components to each other promotes localized tension and torque stresses in the components. More particularly, if the motor casing is made of relatively thin metal sheet, which is often desirable, such as steel sheet from 0.5 to 2.0 millimeters thick, for example, the direction of the pull exerted by spaced rods which connect the end members and urge them against the casing, is spaced away from the cross-sectional area of the casing and induces stresses both in the casing and in the end members. Moreover, such rods, if they pass inside the

casing and through the stator assembly are magnetically disturbing and, if they are located outside the casing, act unfavourably on the end members, spoil the outward appearance of the motor, increase its overall dimensions, and so on. Also a very precise fitting of such rods, parallel to the motor axis, is difficult and costly to ensure.

From one aspect the invention consists in a method of assembling an electric motor of the kind described comprising individually manufacturing said components; providing said ends of said middle component and said peripheral portions of said end components with parts designed for overlapping upon abutment of said components; forming recesses in the overlapped areas of said parts in said end components; coaxially abutting and interfitting said components to produce said overlapping and at the same time fitting a shaft carrying a rotor in said bearings; and fixedly securing said components to each other by permanently deforming the overlapping parts of the middle component into said recesses.

From another aspect the invention consists of an electric motor of the kind described wherein said middle component consists of a thin-walled tubular member of uniform thickness and is fixedly secured to the end components by having selected areas at its ends adjacent to locations where said components abut on each other overlapping and permanently deformed for engagement within recessed parts of said end components.

Thus the invention provides a method by which the various frame components can be co-axially secured to each other by preliminarily positioning said components in a relative position, which can be termed an "assembly position", wherein the desired co-axiality is provided, and then by the permanent deformation of the middle component, without modifying said assembly position and at the same time maintaining the said co-axiality.

Another important advantage of the invention is that any gap between the thus-fastened components is positively eliminated by the permanent deformation, so that the desired highly accurate co-axial relationship in which the components are kept while performing the permanent deformation is further improved. Another advantage is that no conventional fastening arrangement using screws, bolts, studs and the like, is needed. An additional and important advantage is the possibility of having the casing made of a relativey thin material, without being subjected to the drawbacks common to conventional thin-walled structures.

In the method according to the invention the middle and the end components are provided with abutting and centering annular surfaces, recesses being provided in the end components into which portions of the middle component can be engaged without a clearance by a permanent deformation thereof, so that a firm axial connection of the components is positively ensured.

The electric motors produced and assembled according to the above method are generally characterized in that their end components are secured to the casing ends by closed lock joints or by any other equivalent engagement of abutting components, obtained by a permanent deformation of the middle component.

Different ways and specific procedures can be made use of for carrying the method of the invention into practice, both as regards the manufacture of the components and their preliminary assembly in the required positions, and for their permanent deformation. For example, the closed lock joint may be formed continuously or discontinuously all along the whole contour of co-abutted components, or it may be restricted to uniformly spaced portions or points of same contour.

In another embodiment of the invention, the casing consists of a body that may be only generally defined as cylindrical, in that its cross-sectional shape may be other than circular, for example approximately polygonal, or it may show an even more complex shape, since it may be provided with longitudinal fins.

In this latter embodiment of the invention, the casing body is made by extrusion, and preferably in a metal that is particularly suitable for such forming procedure, such as aluminium.

The permanent deformation necessary according to the invention is performed on said cylindrical middle component on the ends thereof abutting with the components, and it has been found that the presence of even closely spaced fins, to allow for an efficient heat dissipation, does not materially interfere with the deformation necessary to provide the permanent connection between the middle component and the end components.

The invention will now further be described with reference to the drawings forming part of this Specification in which:—

Figure 1 is a fragmentary, partly-sectioned view of an electric motor, omitting those details that are not essential to the invention;

Figure 2 is a fragmentary sectional view of components of the motor of Figure 1, after preliminary assembly but before completion;

Figure 3 is a fragmentary exploded view of the components of the same motor;

Figure 4 is a fragmentary cross-sectional view taken on the line IV—IV in Figure 3;

Figure 5 is a similar cross-sectional view takan through a modified embodiment of the motor end component;

Figure 6 is a view similar to that of Figure 1 illustrating another embodiment of the invention; and

Figure 7 is a cross-sectional view of the same motor taken through different planes as indicated by the line VII—VII-VII-VII in Figure 6.

In the embodiment of Figures 1 to 5, the motor comprises a tubular casing 10 with the stator assembly 12 fastened therein in known manner, and two end plates 14 (only one of which is shown). Each end plate carries a bearing 16 wherein the motor shaft 18 is rotatably supported, this shaft being made fast to the rotor assembly 20. As can be readily appreciated, these structural components must be manufactured and assembled in such a manner as to ensure the most accurate co-axiality of the stator inner surface 22 and the rotor outer surface 24 in order to minimize and make uniform the air gap between the magnetically linked components.

The casing 10 is advantageously made of thin-walled steel drawn or welded tubing 26 having a relatively small wall thickness when compared with the conventionally dimensioned casings. Recourse is preferably made, for the production of said body 26, to a metal or alloy that can be permanently deformed, and in which such deformation is rigidly maintained, at least in the edge portions 28 of the tubular body.

The end plates 14 are fitted with a peripheral rib 30, acting as a centering annulus about which the adjacent end 28 of casing 26 can be fitted, said rib having at least one projecting portion and at least one recessed portion formed by a continuous annular groove, such as indicated at 32 in Figures 2, 3 and 4, or by notches suitably spaced thereon, such as indicated at 32^1 in Figure 5, in order to allow for the formation of a closed lock joint between the abutting components, as exemplified and indicated by the reference numeral 34 in Figure 1.

The closed lock joint or permanent deformation must be performed by a force sufficient to ensure a firm grip between the thus-connected components. By such a pressure grip, the necessity of maintaining close tolerances in the previous machining of the components is wholly obviated or at least greatly reduced, since any possible small clearance is thus eliminated. Moreover, the pressure grip is uniformly distributed all around the end plate contour therby preventing any danger of degradation of the designed co-axiality conditions, that might be caused by a different tightening (or possible loosening) of screws or bolts, which heretofore have been spaced thereabout to provide the fastening.

The casing 26 in this embodiment is wholly cylindrical and uniform throughout which has obvious production advantages. However, when the construction and use of the motor require greater heat dissipation, the end plates may be formed with continuous or discontinuous annular projections, grooves, performations or the like, to provide joining recesses or undercuts.

In the embodiment shown in Figures 6 and 7, for example, end components similar to those above described are made use of and their parts are indicated by the same reference numerals, but the cylindrical body 46 is formed with fins 49 and the closed lock joint is formed at the points 54 in the intervals between adjacent fins.

As shown in Figures 6 and 7, the interior of the casing is cylindrical, whilst the fins terminate on a square having curved sides and rounded-off corners. However, the cross-sectional shape may, of course, be different and possibly more complex.

The components of a motor are initially arranged and maintained, by proper support means, in their relative arrangement and co-axiality and then secure to each other by producing the desired permanent deformation. In the motor according to the invention an even noticeable rotational disarrangement of the end members, which are not directly connected to each other, is irrelevant and can be disregarded, so that there is a substantial saving in labour-time in the preliminary assembly of parts, only the co-axiality and parallelism of said end components having to be ensured. Further, the pressures and the stresses applied to the parts, to ensure a firm and permanent grip, are noticeably smaller than those applied by conventional tightening of bolts, nuts and threaded bars arranged in spaced relationship about the axis of the motor, and the stresses applied in the direction of the axis or parallel thereto are minimized in a motor according to the invention.

WHAT I CLAIM IS:—

1. A method of assembling an electric motor of the kind described comprising individually manufacturing said components; providing said ends of said middle component and said peripheral portions of said end components with parts designed for overlapping upon abutment of said components; forming recesses in the overlaped areas of said parts in said end components; coaxially abutting and interfitting said components to produce said overlapping and at the same time fitting a shaft carrying a rotor in said bearings; and fixedly securing said components to each other by permanently deforming the overlapping parts of the middle component into said recesses.

2. A method as claimed in Claim 1, comprising manufacturing said middle component at least at its ends of a material adapted for permanent deformation, and said end components with circular rims at their peripheral portions, said rims having substantially cylindrical radially outwardly facing surfaces having recesses formed therein; fitting said ends about said surfaces to overlap said recesses; and inwardly permanently deforming selected areas of said ends where overlapping said recesses.

3. A method as claimed in Claim 2, comprising forming an uninterrupted annular ra-

dially outwardly facing recess in the said surface of each said end component; fitting said middle component ends to overlap said surfaces and recesses of said end components; and securing said components to each other by inwardly deforming the entire contour of said ends for uninterruptedly engaging said recesses.

4. A method as claimed in Claim 2, comprising forming individual recesses spaced about said substantially cylindrical surfaces of said end components; fitting said middle component ends to overlap said surfaces and recesses of said end components; and securing said components to each other by inwardly deforming spaced areas of said ends where overlapping said recess.

5. A method as claimed in any one of Claims 1 to 4, comprising manufacturing said middle component from a thinwalled tubular material of uniform thickness.

6. A method as claimed in Claim 1, comprising manufacturing said middle component as a tubular member having a substantially cylindrical inner surface to which said motor stator is secured, having radially outwardly projecting fins integral with its outer surface, and having selected areas of its ends adapted for permanent deformation.

7. A method as claimed in Claim 6, comprising forming said tubular member with spaced longitudinal fins extending from and between said ends; fitting said finned ends about the recessed substantially cylindrical surfaces of said end components; and securing said components to each other by inwardly deforming said ends at selected areas located between adjacent fins.

8. A method as claimed in Claim 7, comprising manufacturing said middle component from a length of extruded metallic stock material.

9. A method as claimed in Claim 1, comprising providing a substantially cylindrical middle component having the motor stator secured therein in a position spaced from said ends; positioning the motor rotor inside said stator, said rotor having the motor shaft secured thereto and said motor shaft having end portions projecting beyond the planes defined by said ends of the middle component; concurrently engaging said end components with respective ends of the middle component while rotatably fitting said shaft end portions in respective bearing means in said end components; positioning said components relatively to each other to ensure co-axiality of said rotor and stator; and permanently deforming selected areas of said ends of the middle component where overlapping said recesses for fixedly connecting said components to each other while maintaining said co-axiality.

10. An electric motor assembled by the method claimed in Claim 1.

11. An electric motor assembled by the method claimed in Claim 9.

12. An electric motor of the kind described wherein said middle component consists of a thin-walled tubular member of uniform thickness and is fixedly secured to the end components by having selected areas at its ends adjacent to locations where said components abut on each other overlapping and permanently deformed for engagement within recessed parts of said end components.

13. An electric motor as claimed in Claim 12, wherein said middle component has fins extending radially outwardly therefrom and permanently deformed parts at its ends at selected areas located between adjacent fins.

14. An electric motor as claimed in Claim 13, wherein said middle component consists of a length of extruded metallic stock material.

15. A method of assembling an electric motor substantially as herein described.

16. An electric motor substantially as herein described with reference to and as illustrated in Figures 1 to 4, Figures 1 to 3 and 5, or Figures 6 and 7 of the drawings forming part of this Specification.

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Sheet 1

Fig.1

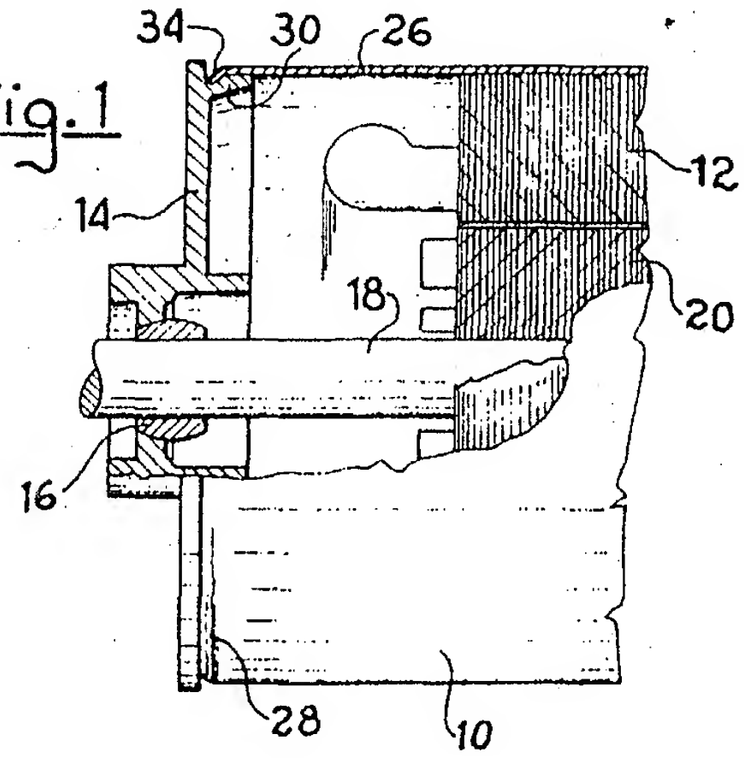


Fig.2

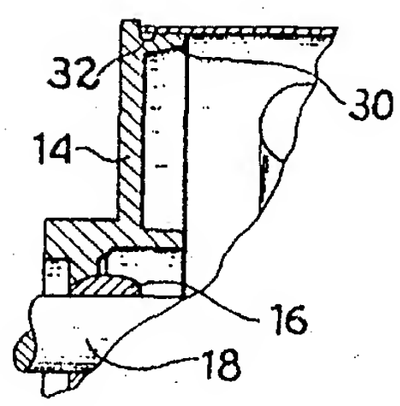
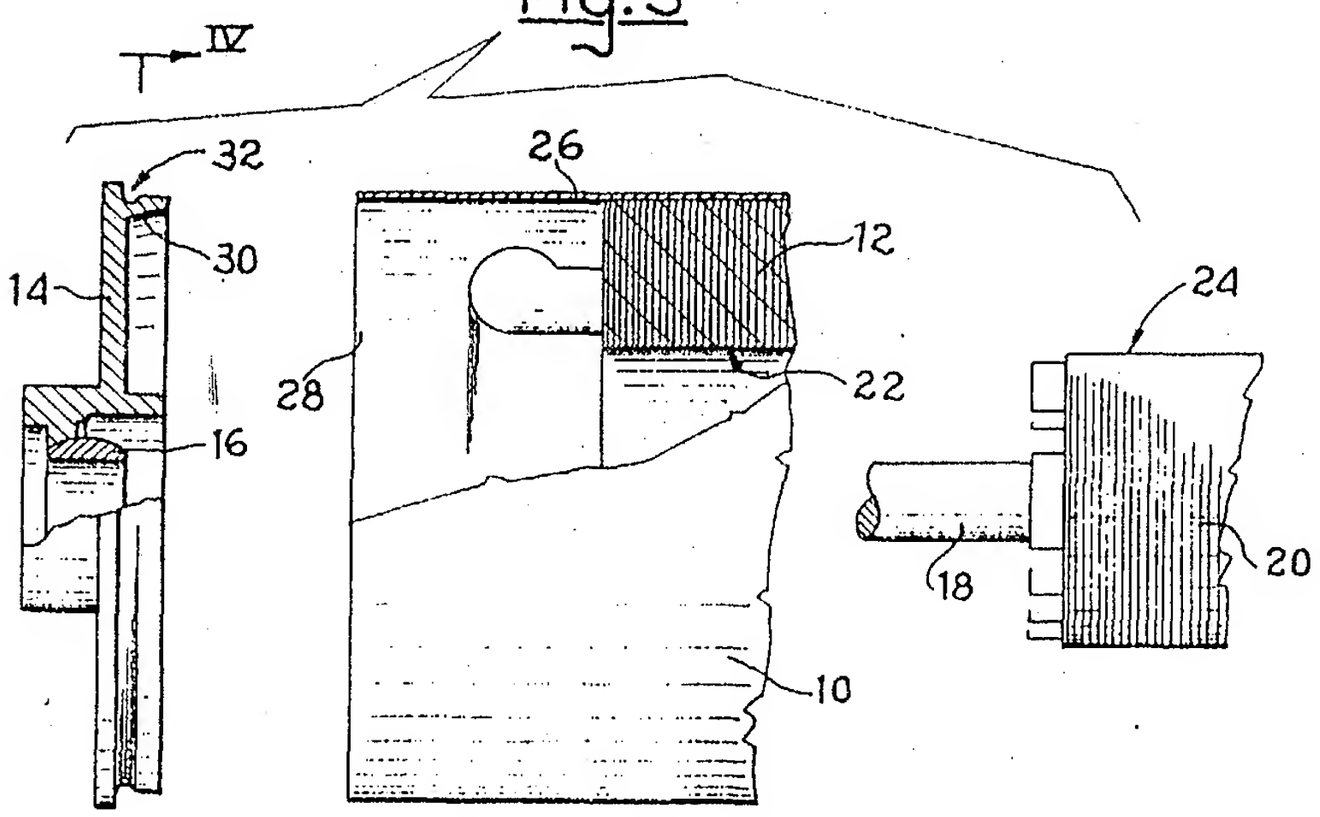


Fig.3



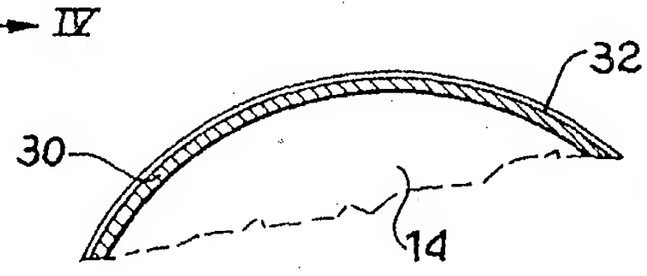


Fig.4

1296429 COMPLETE SPECIFICATION
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Sheet 2

Fig.5

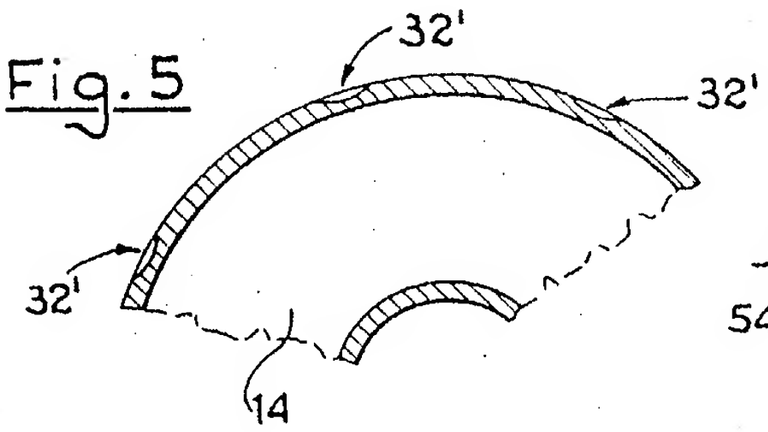

Fig.6

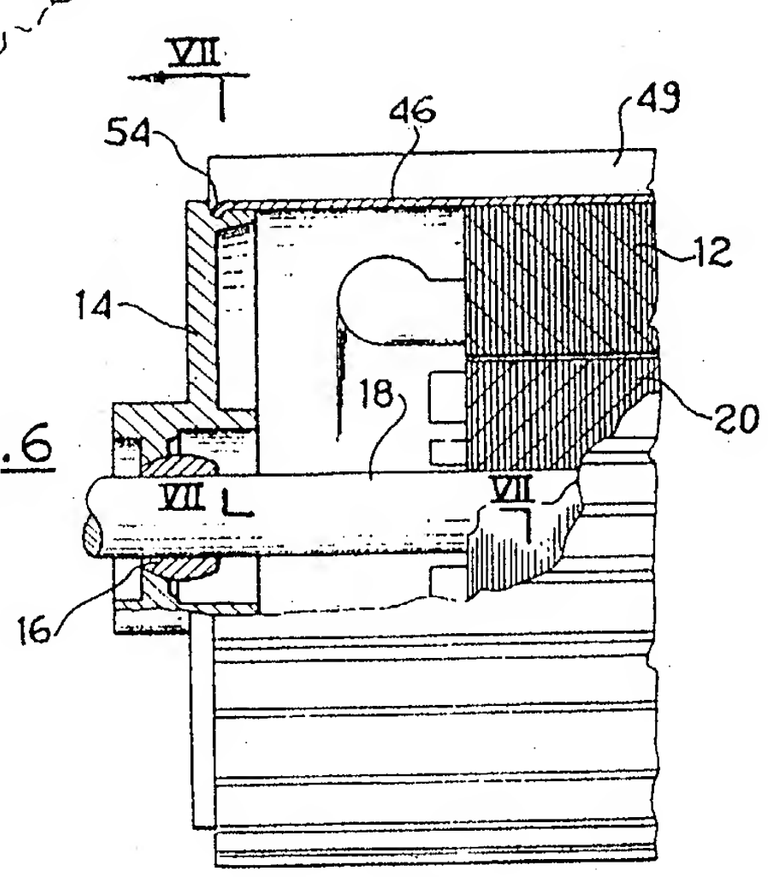

Fig.7